Teaching Mathematics to Non-Sequential Learners

Linda Kreger Silverman, Ph.D.
Gifted Development Center

In our case files, we have dozens of students who show superior grasp of mathematical relations, but inferior abilities in mathematical computation. These students consistently see themselves as poor in mathematics and most hate math. This situation is terribly unfortunate, since their visual-spatial abilities and talent in mathematical analysis would indicate that they are "born mathematicians."

Visual-spatial abilities are the domain of the right hemisphere; sequential abilities are in the domain of the left hemisphere. The test performance patterns demonstrated by this group of students seem to indicate unusual strengths in the right-hemispheric tasks, and less facility with left-hemispheric tasks. In order to teach them, it is necessary to access their right hemispheres. This can be done through humor, use of meaningful material, discovery learning, whole/part learning, rhythm, music, high levels of challenge, emotion, interest, hands-on experiences, fantasy and visual presentations.

Sequentially-impaired students cannot learn through rote memorization, particularly series of numbers, such as math facts. Since the right hemisphere cannot process series of non-meaningful symbols, it appears that these spatially-oriented students must picture things in their minds before they can reproduce them. For example, in taking timed tests, they first have to see the numbers before they can do the computation. This material apparently gets transmitted to the left hemisphere so that the student can respond. This takes twice as long for them as it does for students who do not have impaired sequential functioning; therefore, such tests appear cruelly unfair to them.

I have found that students can learn their multiplication facts in less than two weeks if they are taught within the context of the entire number system. I have them complete a blank multiplication chart as fast as they can, finding as many shortcuts as possible. That may take some assistance, but it enables them to see the whole picture first, before we break it down into parts. I ask them to look for shortcuts to enhance their ability to see patterns. After it is completed, we look mournfully at the table and bemoan the fact that there are over 100 multiplication facts to memorize. Then I ask how we cut down the number of items to learn.

First, we eliminate the rows of zeros, since anything times 0 equals 0. Then we eliminate the rows of 1s, since anything times 1 equals itself. Then, we do the tens and the student happily announces that these are easy, since you just put a zero after the multiplier. By this time, the student usually notices that there are three rows of zeros, ones, and tens, and that one half of the chart is a mirror image of the other half. When we fold it on the diagonal, from the top left corner to the bottom right corner, that becomes even clearer. I ask how this happens and the student discovers the commutative principle: that a x b = b x a. This certainly cuts down on the task of memorization considerably! If one knows 4 x 6 = 24, one also knows that 6 x 4 = 24.

Many visual-spatial students can skip count by their 5s, because 0, 5, 0, 5 is rhythmic and an easy pattern to see. Then I ask them to count by 2s. If they count by 2, they can multiply by 2.

Next, I teach one of several shortcuts for multiplying by 9s. The easiest one I know is to subtract one from the number of nines being multiplied, then find a number which, when added to the first number, results in the sum of nine. For example, in 8 x 9, the following process would occur: subtract 1 from 8, leaving 7. What plus 7 equals 9? (2). The answer is 72, since 7 is one less than 8, and 7 plus 2 add up to 9.

There are other tricks for memorizing the 9s times tables, including the finger method found in *Upside-Down Brilliance: The Visual-Spatial Learner* (page 304). Visual-spatial students are excellent at seeing patterns and there are patterns galore in the 9s column. For example, every answer has a mirror image. Also, as the tens column increases by one digit, the ones column decreases by one digit:

09
18
27
36
45
54
63
72
81
90

Note that 09 at the top is the mirror image of 90 at the bottom, and so forth. The tens column is 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, while the ones column is 9, 8, 7, 6, 5, 4, 3, 2, 1, 0.

There are several other tricks. They can remember that you have to be 16 do drive a 4 x 4 (4 x 4 = 16)! Also, 1, 2, 3, 4 is 12 = 3 x 4 and 5, 6, 7, 8 is 56 = 7 x 8. Rhyming equations are easy to recall: 6 x 4 = 24, 6 x 6 = 36, 6 x 8 = 48. Another benefit to these tricks is that students learn division at the same time. If you have a picture of being 16 to drive a 4 x 4, you can simultaneously see that 16 divided by 4 equals 4. I try to teach them all of the doubles at one time, from 2 x 2 to 9 x 9. Doubles seem to be easier than some of the others, since they have a natural rhythm.

Young children like to play games where they count by 3s. There is also a video from Schoolhouse Rock called *Multiplication Rock*, that has catchy tunes for memorizing math facts, particularly the 3s. Sixes can be taught as doubles of threes. These tricks reduce the number of difficult math facts to only a few – usually ten or less.

I ask students to make up a real problem for each of the remaining math facts with which they have difficulty. I ask them to draw a picture (not use stickers) for each problem. The picture needs to include something they are emotionally attached to, such as a favorite animal or food. For example, if they love ice cream, and they are trying to learn 3 x 7, I ask them to draw 7 ice cream cones, each with 3 scoops of ice cream. They write, "3 x 7" at the top of their picture and "7 x 3" at the bottom and then count up all the scoops to arrive at the answer. For 4 x 6, they might draw 6 horses and give each of their horses 4 carrots. They put these pictures up on the wall in their bedroom
until they've created a permanent mental image. These methods bring the facts to life, enabling students to visualize them and create meaningful associations for them. Manipulatives and calculators should also be encouraged. Students should be informed that mathematics is more than calculation. Those who have difficulty with multiplication may be brilliant at geometry, which is non-sequential. Algebra and chemistry are highly sequential, but geometry and physics are spatial. Students with right-hemispheric strengths should be introduced to geometric and scientific principles at the same time that they are struggling with calculation so that they do not come to see themselves as mathematically incapable. In a world of calculators and computers, the computational wizard is all-but-obsolete.

Division is often quite difficult for these students, since it is usually in a step-by-step fashion and these students are lost after the second step. They are not step-by-step learners. They would learn much more rapidly if they were simply given a divisor, a dividend and a quotient and asked to figure out their own method of arriving at the quotient. *Don't ask them to show their steps.* Just give them another problem with the solution already worked out and see if their system works. Gradually increase the level of the problems to test their system. This way of teaching is a lot like the methods used in video games. Even in adult life, these individuals will do beautifully if they know the goal of an activity, and are allowed the freedom to find their own methods of getting there.

Timed tests should be avoided, since it takes longer for visual-spatial learners to translate their images into words. *Timed activities should only be used if students are competing with themselves rather than others.* If a student has continued difficulty completing assignments in the same time frame as classmates, a comprehensive assessment should be conducted to determine if the student has a processing speed problem. The teacher should modify the amount of time given and record those modifications in the student's permanent record. This will assist the student in qualifying to take college board examinations with extended time. With this type of assistance, non-sequential learners can blossom and become highly successful.

Reference

Silverman, L.K. (2002). *Upside-down brilliance: The visual-spatial learner.* Denver: DeLeon.

Linda Silverman, Ph.D., is a licensed psychologist and director of the Gifted Development Center in Denver, Colorado

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